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DETERMINING OPTIMUM ETHOXYQUIN APPLICATION FOR A NEW LOW VIT A DEHY

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DETERMINING OPTIMUM ETHOXYQUIN APPLICATION RATES FOR A NEW LOW VIT A DEHY

Final Report
ADF Project 20040465

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Abstract

Ethoxyquin was applied at 75, 150 and 225 ppm on commercial dehy alfalfa pellet production runs containing Vit A contents ranging from 51,000 to 128,000 IUPP. Vit A lost at the 150 and 225 ppm ethoxyquin rates were totaling 20% after five months of storage. Vit A loss at the 75 ppm ethoxyquin application rate was higher at 27%. The percentages lost were similar regardless of initial dehy Vit A content; especially at the 150 and 225 ppm ethoxyquin rates. However, the quantitative loss of Vit A was about 2,000 IUPP/mo lower in the dehy containing lower levels of Vit A. This observation conforms with the biological "half-life" phenomena. **It is recommended that** the ethoxyquin application rate for the new 50,000 IUPP dehy be **reduced to no less than** 100-125 ppm. For additional information refer to the final report online.

Summary

A study was conducted to determine if the current recommended ethoxyquin application rate of 150 ppm (0.015%) can effectively be reduced for the new export standard of 50,000 IUPP Vit A in dehy alfalfa without affecting Vit A quantity lost during storage. Ethoxyquin was applied at 0.0075, 0.015 and 0.0225% (75, 150 and 225 ppm) on six commercial dehy alfalfa pellet production runs having Vit A contents ranging from 51,000 to 128,000 IUPP. Hot pellet samples taken from each production run were cooled to 25-30 C; then stored at room temperature for five months under darkness. Monthly sub-samples of the stored samples were analyzed for Vit A, moisture, ethoxyquin and protein in accordance with the experimental protocol.

Measured levels of ethoxyquin in the samples at the outset of the storage period were very close to the amounts actually applied except for the 75 ppm application rate where the measured rate averaged 125 ppm. No explanation for this discrepancy could be found. Ethoxyquin levels in the dehy samples decreased steadily during the test; with approximately 30% of the initial ethoxyquin concentration being lost after five months of storage.

As expected, the percent of Vit A lost at the 150 and 225 ppm ethoxyquin rates were very similar, totaling 20% after five months of storage. Vit A loss at the 75 ppm rate was higher at 27%. These findings generally agree with earlier studies on dehy alfalfa.

Although the percentages lost were similar regardless of initial dehy Vit A content; especially at the 150 and 225 ppm ethoxyquin rates, there were differences in the quantitative loss of Vit A. The loss in the dehy containing lower levels of Vit A was about 2,000 IUPP/mo lower compared to the higher Vit A dehy. This observation conforms with the biological "half-life" phenomena; whereby the time it takes for one-half of a specific substance to degrade is the same regardless of its initial concentration.

By simply going from the old 125,000 IUPP export standard to the current 50,000 IUPP standard, a theoretical reduction in storage loss of approx. 3,000 IUPP Vit A /mo. could be expected. Likewise, when comparing the average 2004 dehy quality of 72,000 IUPP Vit A with the previous five year average of 110,000 IUPP, storage loss of Vit A would have been less by roughly 1,400 IUPP per month simply due to the biological "half-life" phenomena. However, if the rate of ethoxyquin was reduced from 150 ppm down to 75 ppm, it could theoretically increase Vit A loss by approx. 2,500 IUPP per month; thereby potentially jeopardizing the plants' abilities to meet the Vit A specifications as the dehy comes out of storage. **Therefore, as a compromise between these two opposing factors, it is recommended that the ethoxyquin**

application rate for the new 50,000 IUPP dehy be reduced to no less than 100-125 ppm (0.010-0.0125%) without unduly jeopardizing the Vit A content of dehy coming out of

storage. Individual plant circumstances, however, will ultimately dictate the application rate required to provide the degree of Vit A protection desired.

Background:

Previous research has indicated that ethoxyquin applied to dehy alfalfa pellets at a rate of 0.015% (150 ppm) provides the most cost-effective and optimum protection of Vit A from oxidative destruction during storage. This rate, which is recommended for dehy alfalfa typically containing 125,000 IUPP Vit A, will limit loss of Vit A to 5-7%/mo (6,000 – 9,000 IUPP/mo) under normal storage conditions. The recent reduction of the Vit A export standard from 125,000 IUPP down to 50,000 IUPP raises the question as to whether the rate of ethoxyquin application can be reduced without a detrimental effect on Vit A stability and loss during storage. If so, a lower rate would effectively reduce the cost of ethoxyquin applied to dehy alfalfa

Objective:

To determine if the current recommended ethoxyquin application rate of 150 ppm can effectively be reduced for the production of the new dehy export standard of 50,000 IUPP Vit A without compromising Vit A stability and quantity lost during storage.

Experimental Procedure:

Various commercial dehy production runs at the Tisdale and Arborfield dehy plants were selected based on their estimated Vit A content as follows:

1) 50-75,000 IUPP
2) 75-100,000 IUPP
3) 100-125,000 IUPP

Two production runs were selected within each quality range, giving a total of six runs. Within each run, ethoxyquin was applied at 0.0075, 0.015 and 0.0225% (75, 150 and 225 ppm). Scoopfuls of hot pellets were taken directly from the pelleter every 20 sec over a 4 min time interval to obtain a representative sample that filled a 4 L container (approx. 2,700 gm). The pellets were immediately cooled to 25-30 C and labelled; then transported to the lab and placed into a freezer until all sample sets were collected.

For the storage phase of the experiment, all samples were placed simultaneously in a dark room and stored at room temperature. Sub-samples were taken at monthly intervals for a period of five months and analyzed for Vit A, moisture and ethoxyquin. Protein analysis was conducted on the 1st and last sub-sample.

Experimental Results

The complete data is presented in the appendix; while data from the six sets of samples analyzed during the tests were grouped into various configurations for purposes of interpreting the findings. The initial quality of the six production runs are presented in Table 1; while the findings are presented in the tables and figures that follow.

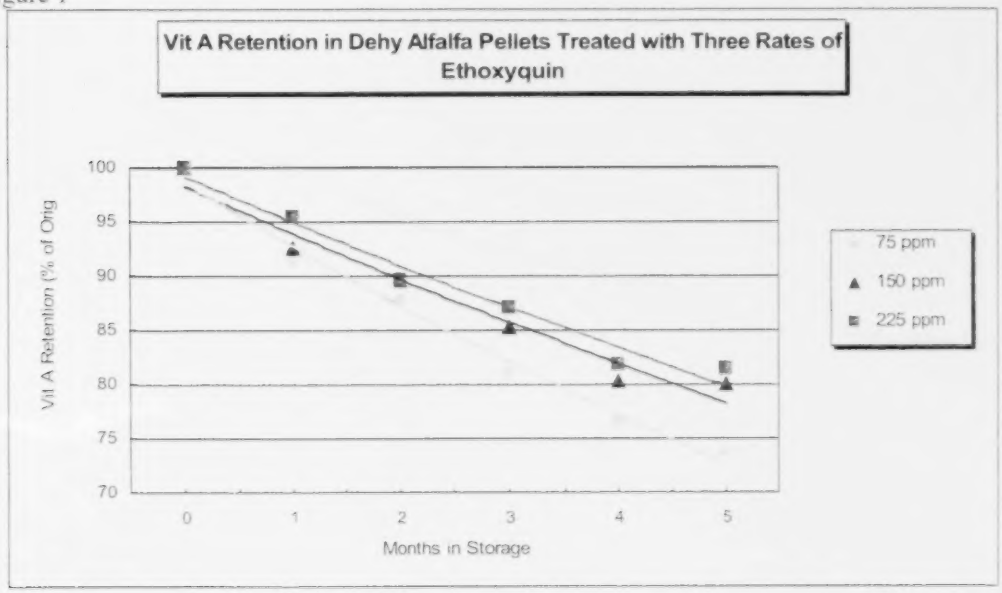
Although not shown, the levels of ethoxyquin actually applied were very close to the targeted rates of 150 and 225 ppm. However, the 75 ppm application rate was actually measured at 125 ppm. No explanation for this discrepancy could be found.

Table 1: Initial quality of dehy within the various production runs.

Prod'n Run No.	Vit A (IUPP)	Crude Protein (%)	Moisture (%)
1	103,000	18.0	7.5
2	76,000	16.3	6.8
3	128,000	18.3	4.8
4	82,000	18.1	3.8
5	86,000	18.8	6.9
6	51,000	14.4	5.8

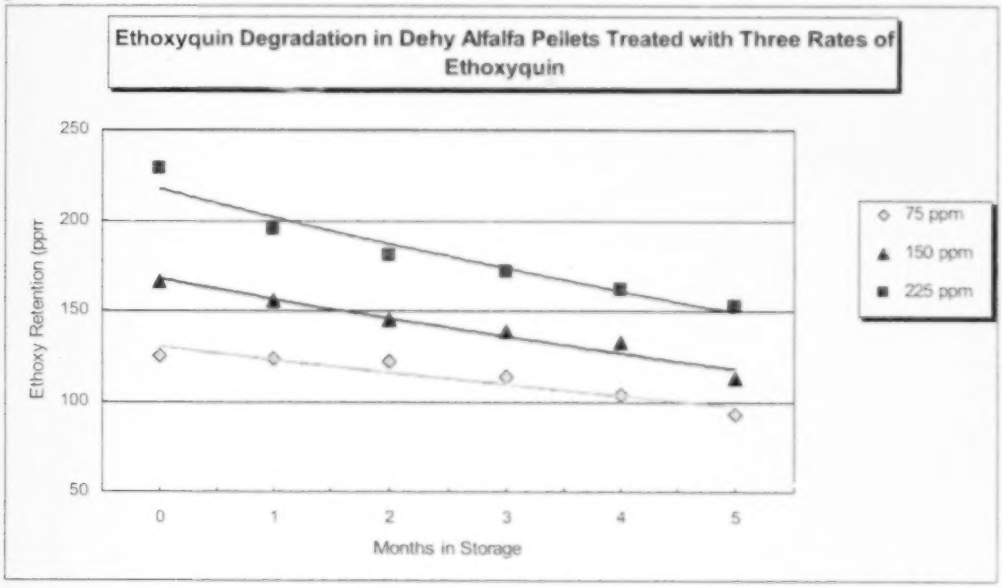
Figure 1 shows the percent of original Vit A retained at the three rates of ethoxyquin when measured over the five month storage period. As expected, the loss of Vit A at the 150 and 225 ppm rates were very similar; totalling 20% overall loss after five months of storage. The overall Vit A loss at the 75 ppm ethoxyquin application rate was somewhat higher at 27%. These findings generally agree with earlier studies on dehy alfalfa; although the rate of Vit A loss in this study was slightly lower than observed in previous studies (4-5%/mo vs 5-7%/mo).

Figure 1



Ethoxyquin degradation in the dehy pellet samples throughout the five month storage period is shown in Figure 2. As expected, there was a steady decrease in the quantity of ethoxyquin as the storage period advanced. This is explained by the mode of action in ethoxyquin; it being used up more readily than the Vit A during the oxidation process.

Figure 2



When the six sample sets were grouped into the three Vit A quality ranges (50-75,000 IUPP, 75-100,000 IUPP and 100-125,000 IUPP), their respective averages were 63,000, 84,000 and 116,000 IUPP Vit A. When expressed as a monthly percentage of loss, the average Vit A lost for the three groups were similar among all three quality groups; especially at the 150 and 225 ppm ethoxyquin application rates (Fig 3). However, when expressing the Vit A loss in terms of IUPP/mo, there was a direct relationship between quantity of Vit A lost vs. its initial Vit A content (Fig 4). In other words, the lower quality (Vit A) samples had a smaller monthly IUPP loss of Vit A. This observation conforms with the biological "half-life" phenomena; whereby the time it takes for one-half of a specific biological substance to degrade is the same regardless of its initial concentration.

Figure 3

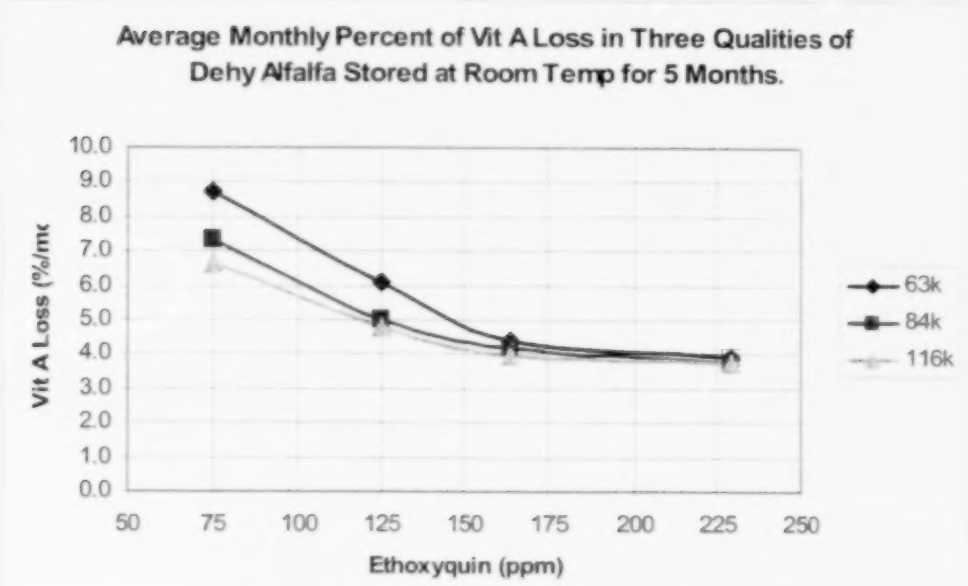
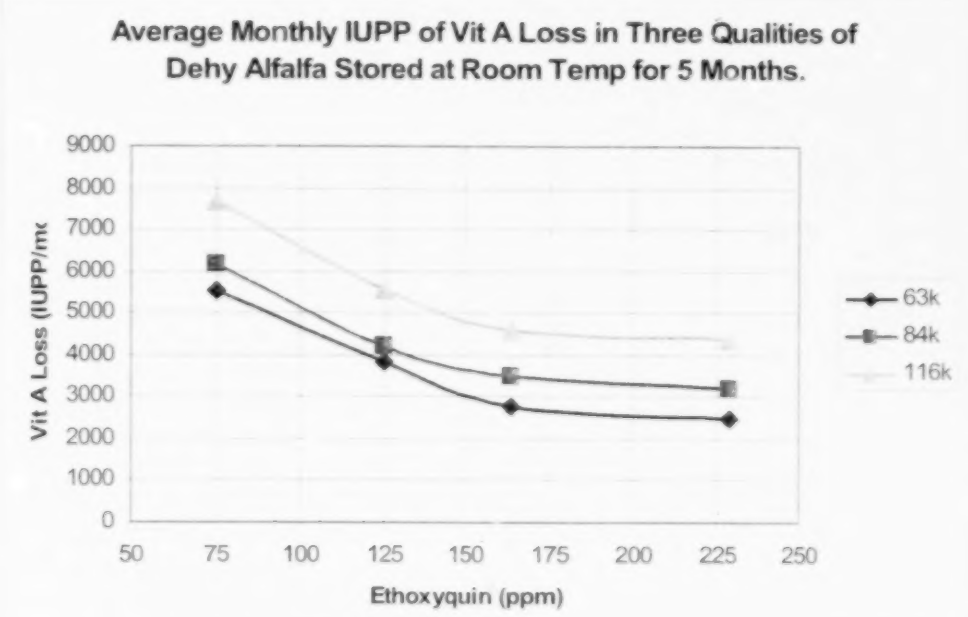


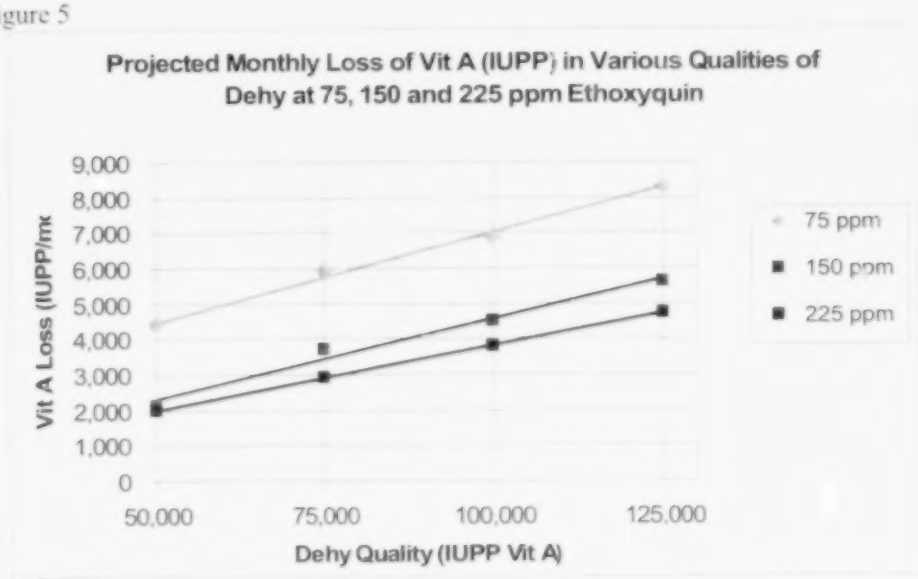
Figure 4



63k = 63,000 IUPP Vit A; 84k = 84,000 IUPP, etc

Figure 5 is a projection of the IUPP of Vit A that is lost per month when various qualities of dehy alfalfa are stored at room temperature under the three rates of ethoxyquin applied in this experiment. It indicates that there is roughly a 1,000 IUPP reduction in loss of Vit A for each 25,000 IUPP decrease in initial quality. Therefore, by reverting from the old 125,000 IUPP export standard to the current 50,000 IUPP standard, a theoretical gain of approx. 3,000 IUPP/mo reduction in Vit A loss can be achieved. This reduction occurs almost independently from the concentration of ethoxyquin applied to the dehy alfalfa.

Figure 5



Conclusions and Recommendations

Because a lower initial quality Vit A dehy loses fewer IUPP's of Vit A during storage, one can conclude that the ethoxyquin application rate can safely be reduced when producing and storing the 50,000 IUPP Vit A dehy. The question is by how much?

By simply going from the old 125,000 IUPP export standard to the current 50,000 IUPP standard, a theoretical reduction in storage loss of approx. 3,000 IUPP Vit A /mo could be expected. Likewise, when comparing the average 2004 dehy quality of 72,000 IUPP Vit A with the previous five year average of 110,000 IUPP, storage loss of Vit A would have been less by roughly 1,400 IUPP per month simply due to the biological "half-life" phenomena. However, had the rate of ethoxyquin been reduced by one-half to 75 ppm, it would have resulted in a theoretical increase in Vit A loss of approx. 2,500 IUPP per month (extrapolated from Fig 5). This could potentially have jeopardized the plants' abilities to meet shipment Vit A specifications coming out of storage.

Therefore, as a compromise between these two opposing factors, it is recommended that the ethoxyquin application rate for the new 50,000 IUPP dehy be reduced to no less than

100-125 ppm (0.010-0.0125%) without unduly jeopardizing the Vit A content of dehy coming out of storage. Individual plant circumstances, however, will ultimately dictate the application rate required to provide the degree of Vit A protection desired.

Acknowledgements

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